

Development of Advanced Anti-Reflection Coatings for High Performance Solar Energy Applications, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



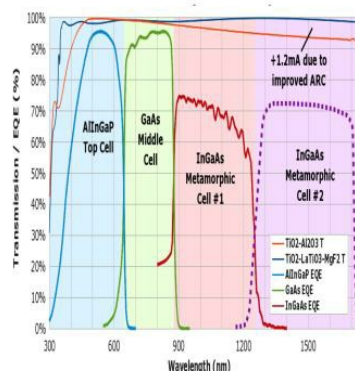
ABSTRACT

MicroLink Devices will increase the efficiency of multi-junction solar cells by designing and demonstrating advanced anti-reflection coatings (ARCs) that will provide a better broadband spectral response than that of conventional anti-reflection coatings. Advanced coatings of this nature are needed to realize the full performance of the forthcoming generation of multi-junction solar cells, which will contain four or more junctions. Two approaches to improving the performance of the antireflection coatings will be investigated: * develop multilayer dielectric antireflection coatings incorporating LaTiO₃ to achieve significantly improved optical coupling between the coverglass and cell at the ultraviolet and infrared ends of the spectral range of interest; and * develop a structure and corresponding fabrication process to oxidize the Al-containing window layer in order to reduce the absorption of light at the short-end of the spectral range of interest, thus providing extra useable photons to the cell. These two technologies will be integrated into a hybrid design which will provide the best possible coupling of light from cover glass to cell in order to achieve the highest possible efficiency in next-generation devices containing four or more junctions. It is expected that the new coatings will enable a relative efficiency increase of at least 7%, corresponding to a 2.5% absolute efficiency increase. The reliability and radiation tolerance of these materials and the solar cells incorporating the new designs will be tested.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The anti-reflection coating (ARC) technology to be developed in the proposed program may be used to increase the efficiency of the multi-junction, Ge-based solar cells currently in use in many NASA applications. It may also be used to increase the efficiency of



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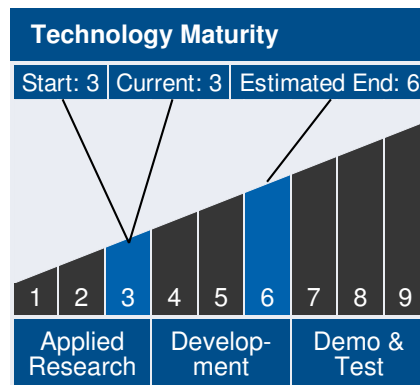
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forthcoming solar cells containing four or more junctions. The ARC technology is also applicable to the lightweight, high-efficiency epitaxial lift-off (ELO) solar cell technology that has been developed by MicroLink. It will therefore be possible to combine the increased efficiency enabled by the new ARC technology with the, ELO solar cells, which will enable a new generation of lightweight, high-efficiency solar panels which will be key to enabling solar electric propulsion (SEP). Similarly, the new anti-reflection coating technology can be used to enhance the efficiency of solar cells for unmanned aerial vehicle (UAV) applications.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The anti-reflection coating (ARC) technology to be developed in the proposed program may be used to increase the efficiency of the multi-junction, Ge-based solar cells currently in use in many commercial applications. It may also be used to increase the efficiency of forthcoming solar cells containing four or more junctions. The ARC technology is also applicable to the lightweight, high-efficiency epitaxial lift-off (ELO) solar cell technology that has been developed by MicroLink. It will therefore be possible to combine the increased efficiency enabled by the new ARC technology with the, ELO solar cells, which will enable a new generation of lightweight, high-efficiency solar panels for commercial applications. Similarly, the new anti-reflection coating technology can be used to enhance the efficiency of solar cells for unmanned aerial vehicle (UAV) applications. Solar cells act as a supplement to the batteries that are used to power some of the current generation of small UAVs. Increasing cell efficiency will result in further endurance enhancement. Lightweight, high-efficiency cells are an enabling technology for high altitude, long endurance (HALE) UAVs, such as DARPA Vulture. Lightweight, high-efficiency solar cells may be used in solar sheets for generation of electricity for high-value, off-grid applications, such as power generation for military



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Project Manager:

- Anna maria Pal

Principal Investigator:

- Victor Elarde

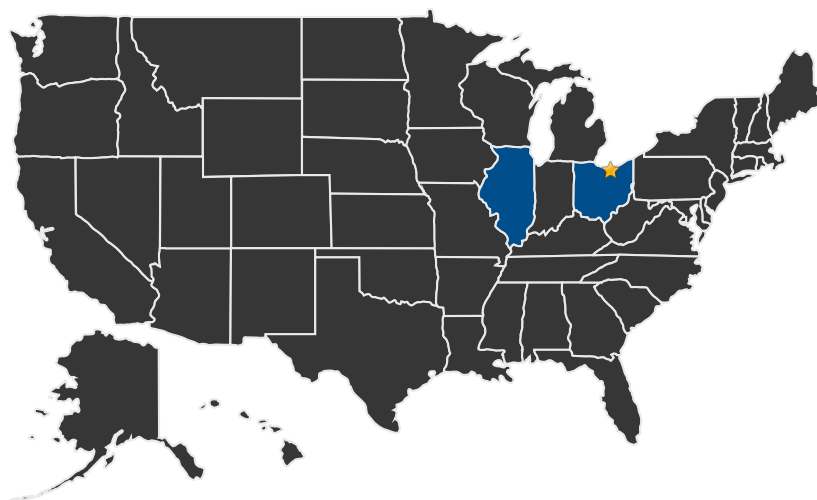
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field deployments, civilian outdoors and camping, and supplementary power for mobile devices such as phones.

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Glenn Research Center

Other Organizations Performing Work:

- MicroLink Devices, Inc. (Niles, IL)

PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23045>)
- Final Summary Chart
 - (<http://techport.nasa.gov:80/file/23801>)

Technology Areas

Primary Technology Area:

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

- └ Manufacturing (TA 12.4)
 - └ Electronics and Optics Manufacturing Process (TA 12.4.3)
 - └ Photovoltaic Solar Cell Manufacturing (TA 12.4.3.1)

Secondary Technology Area:

Space Power and Energy Storage (TA 3)

- └ Power Generation (TA 3.1)
 - └ Solar (TA 3.1.3)

Additional Technology Areas:

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

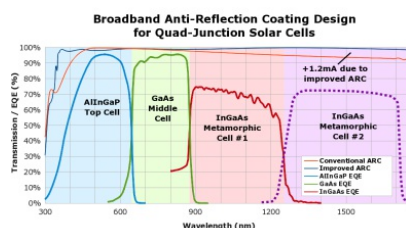
- └ Manufacturing (TA 12.4)

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IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

Development of Advanced Anti-Reflection Coatings for High Performance Solar Energy Applications

Potential Applications

The anti-reflection coating (ARC) technology to be developed in the proposed program may be used to increase the efficiency of the multi-junction, Ge-based solar cells currently in use in many NASA applications. It may also be used to increase the efficiency of forthcoming solar cells containing four or more junctions. The ARC technology is also applicable to the lightweight, high-efficiency epitaxial lift-off (ELO) solar cell technology that has been developed by MicroLink. It will therefore be possible to combine the increased efficiency enabled by the new ARC technology with the, ELO solar cells, which will enable a new generation of lightweight, high-efficiency solar panels which will be key to enabling solar electric propulsion (SEP). Similarly, the new anti-reflection coating technology can be used to enhance the efficiency of solar cells for unmanned aerial vehicle (UAV) applications.